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interpretation of these, M. Villarceau thinks that upon the whole the solution which gives a period of 66 years is the more probable. He remarks, however, that in four years at the furthest the doubt will be settled. In 1853·677 the angle of position given by the 66-year solution will be 303° 44′, while that given by the 43-year solution will be 356° 30′, leaving a difference upon which there can be no doubt. The distances will be respectively 0″·51 and 0″·77, but between these it might be difficult to pronounce.

On the Practicability and Advantages of obtaining a Sea-rate for a Chronometer. By H. Toynbee, Esq., late Commander of the Ellenborough, East Indiaman.

Having found by experience that lunar observations taken Sun E. and Sun W.* give very different Greenwich Times, Capt. Toynbee has adopted the following method of combining his results in settling the rate and error of his chronometer:—

Having made numerous careful sets of lunar distances, Sun E. and Sun W., whenever an opportunity occurred, Captain Toynbee works out the error and rate of his chronometer as in the following instance. Having found from the means of several sets on several days,

1848. d	Sun E. of Moon. Error Chron. m s	d	Sun W. of Moon. Error Chron. m s
Aug. 24·0	−3 31·4	Sept. 3·4	−6 1·3
Sept. 18·5	−6 52·2		
Loss in 25·5	−3 20·8	Daily rate −0^{m} 7^{s}·88	

Now, bringing up the error found on Sept. 3·4, Sun W., by 15·1 × −7^{s}·88, or 1^{m} 59^{s}·0, we have the following chron. errors:—

d		m s
Sept. 18·5	Sun E., Chron. slow	6 52·2
	Sun W.	8 0·3
	Mean	7 26·3

With this final error for Sept. 18·5 and rate −7^{s}·88, the chronometer being brought up to October 1st, was found to be slow 9^{m} 4^{s}·8; the flash of the signal-gun at Madras shewed it actually slow 9^{m} 20^{s}·3, *i. e.* the error in longitude was only about 4′. It should be remarked that the chronometer had fallen from its stand in a gale of wind on August 20th, and that Madras was made without reference to any other rate or error than that deduced above, *i. e.* from lunar distances observed after the accident.

A more extended series is added to shew the coincidence of the partial results obtained by Capt. Toynbee on his return:—

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* There are many reasons why lunar distances from the sun are preferred to those from the planets and stars, and we believe they are more commonly observed.

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		Sun E. of Moon. Chron. Error.				Sun W. of Moon. Chron. Error.	
1848.	d	m	s	1849.	d	m	s
Dec.	20·3	−18	29·0	Jan.	0·4	−20	45·4
1849.							
Jan.	17·2	22	11·2		30·3	24	35·0
Feb.	16·6	25	59·9	March	0·8	28	15·7
March	18·4	−30	1·0		27·0	−31	37·3

from which the following daily rates were concluded, viz.,

Sun E. $-7^{s}\cdot96$, $-7\cdot52$, $-8^{s}\cdot09$; Sun W. $-7^{s}\cdot68$, $-7^{s}\cdot48$, $-7^{s}\cdot69$

The final chronometer-errors are found thus:—The error, Sun E., of Dec. 20·3, is brought up to Jan. 0·4 by the rate $-7^{s}\cdot96$, and a mean is taken between this and the error actually obtained, Sun W., at the same date. In the same way the error, Sun W., on Jan. 0·4, is brought up to Jan. 17·2 by its proper rate $-7\cdot68$; and a mean is taken between this and the error, Sun E., at the same date. Thus Capt. Toynbee finds, for the final errors of his chronometer,

		Chron. Error.				Chron. Error.	
1849.	d	m	s	1849.	d	m	s
Jan.	0·4	−20	21·4	March	0·8	−27	53·4
	17·2	22	35·2		18·4	30	19·5
	30·3	24	13·4		27·0	−31	22·2
Feb.	16·6	−26	22·5				

The *actual* error, on March 27 = −31 13·6

Capt. Toynbee says: "I felt such confidence in my chronometer (Dent, 1735), corroborated as it was by all the lunar observations taken during the voyage, that on my return to England, though no land had been seen since leaving Cape Town—a northerly gale blowing as I entered the English Channel—I ventured to steer for passing within a few miles of St. Agnes Light, and sighted it in the middle of the night, bearing as my calculation had led me to expect."

The sextant employed was by Cary, with blue glasses; and care was taken that the telescope was always drawn out to the same length, the wires always in the same position, the elevating screen always raised the same quantity, and the same shades invariably used for the observation itself, and for the determination of index-error. The measured semidiameter of the sun seldom agreed with the *Nautical Almanac* nearer than within 3″ or 4″; and the lunar distances, Sun E., generally made the chronometer from 40^{s} to 50^{s} faster than the lunar distances Sun W.*; but, from the mode of treatment, errors of this kind have no influence on the rates or on the concluded errors.

Capt. Toynbee adds: "I have hitherto limited myself to observations of the sun and moon, but in a future voyage it is my intention to apply the same method to the angular distances between the moon and the planets and stars, which will probably allow of a rate being determined at an earlier period of a voyage." If the observations can be as well made, the results would certainly be

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* This looks like a constant error in the observer, or in the dark shade. The results from different *distances* seem accordant.

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preferable, since the final error would be obtained immediately; and if the east and west distances were properly combined, the instrumental errors and errors of observation would be eliminated. This is indeed the practice of the best navigators, who do not regard a little extra trouble when the safety of their vessel is in question, and of all competent observers who use lunars in geographical determinations.

In pointing out the advantages of this method of rating, its *independence* is very properly insisted upon. The seaman who employs it relies on his shore-rate for a very short time, and has a sufficient check even upon that. Capt. Toynbee thinks (and it is an almost universal opinion) that the sea-rate of a chronometer differs considerably from the shore-rate; and this is probably true to some extent, in some cases, though Mr. Hartnup, from his experience at Liverpool, has come to a different conclusion. As a general rule, Mr. Hartnup finds that a first-rate chronometer, which is not exposed to *sudden* changes of temperature, goes at sea, keeping pretty nearly the same rate as in his observatory, *at the same temperature,* if it rests nicely in its gimbals. It is presumed that a steady place is selected for the chronometers, and that they are not exposed to extraordinary magnetic influence.

Captain Toynbee found the rate altered by disturbing his cargo. It was about $-7^{s}{\cdot}8$ before his arrival at Calcutta, and kept steady for a few days until the ship began to discharge, when it gradually changed to $-6^{s}{\cdot}5$. The old rate was, however, taken up again at sea.

Ephemeris of Iris. By Mr. Pogson.

For 12^{h} Greenwich M.T.

1849.		R.A.			N.P.D.			H.P.	1849.		R.A.			N.P.D.			H.P.
		h	m	s	°	′	″	″			h	m	s	°	′	″	″
May	16	9	48	36·81	83	5	44·9	3·56	June	19	10	24	49·73	85	28	32·7	
	18		50	24·56		11	12·1			21		27	15·14		39	52·9	2·92
	20		52	15·40		17	3·8	3·47		23		29	42·00	85	51	30·0	
	22		54	9·22		23	19·5			25		32	10·24	86	3	23·6	2·86
	24		56	5·88		29	58·8	3·39		27		34	39·78		15	33·2	
	26	9	58	5·27		37	1·2			29		37	10·57		27	58·4	2·81
	28	10	0	7·26		44	26·2	3·31	July	1		39	42·54		40	38·6	
	30		2	11·71	83	52	13·2			3		42	45·65		53	33·5	2·77
June	1		4	18·52	84	0	21·8	3·24		5		44	49·82	87	6	42·5	
	3		6	27·54		8	51·3			7		47	25·02		20	5·1	2·72
	5		8	38·70		17	41·4	3·17		9		50	1·20		33	40·0	
	7		10	51·90		26	51·6			11		52	38·34	87	47	29·9	2·68
	9		13	7·07		36	21·5	3·10		13		55	16·40	88	1	31·5	
	11		15	24·12		46	10·6			15	10	57	55·37		15	45·8	2·64
	13		17	42·98	84	56	18·6	3·04		17	11	0	35·21		30	12·6	
	15		20	3·58	85	6	45·2			19	11	3	15·91	88	44	51·9	2·60
	17	10	22	25·85	85	17	30·0	2·98									

"The right ascension is reckoned from the true equinox, and the ephemeris is corrected for aberration."

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